



The invention relates to a circuit arrangement for operating a discharge lamp, provided with a DC-AC converter and with a starter circuit for starting the DC-AC converter, in which starter circuit means are present for generating a starting pulse through charging of capacitive means.

A circuit arrangement of the kind mentioned in the opening paragraph is known from US 4,042,852. The known circuit arrangement is suitable for connection to an AC-voltage source of 50 to 60 Hz, the supply voltage being delivered to the DC-AC converter after full-wave rectification and through a buffer capacitor. As a result, the starter circuit for starting the DC-AC converter and thus for charging the capacitive means only serves to generate a starting pulse for starting the DC-AC converter after connection to the supply voltage.

In modern circuit arrangements, which also comprise the possibility of controlling the luminous flux generated by the lamp, the DC-AC converter is supplied by means of a comparatively high DC voltage which is realised by means of a switch-mode power supply. Control of the luminous flux is realised then in that the operation of the DC-AC converter is periodically shortly interrupted. Under such circumstances it is necessary for the starter circuit to generate starting pulses in quick succession. It is usual for the periodic interruption to take place with a repetition frequency having a value situated in the range from approximately 100 Hz to approximately 100 kHz. The duration of the interruption may then lie between 0 and 1 time the period of the repetition frequency.

The invention has for its object *inter alia* to provide a measure by which a switching arrangement of the kind described in the opening paragraph is also suitable for controlling the luminous flux of the lamp.

A switching arrangement of the kind mentioned in the opening paragraph is for this purpose characterized in that the starter circuit comprises discharging means for discharging the capacitive means and disconnecting means for keeping the starter circuit disconnected.

The use of discharging means for discharging the capacitive means provides the possibility for the starter circuit to generate starting pulses with a high frequency. However, to prevent the starter circuit generating starting pulses at moments at which the DC-AC converter is already operating, the generation of starting pulses is advantageously suppressed through the use of disconnecting means for keeping the starter circuit disconnected. Preferably, the disconnecting means are so dimensioned that the starter circuit is disconnected after the generation of a first starting pulse and is kept disconnected until the operation of the DC-AC converter is interrupted.

In an advantageous embodiment of a circuit arrangement according to the invention, in which the means for generating starting pulses comprise a switch in a charging circuit of the capacitive means, the disconnecting means preferably comprise a switching element for controlling the switch in the charging circuit. A reproducible and reliable disconnection of the starter circuit can be realised by simple means in this manner.

The necessity of having a fast discharge possibility for the capacitive means of the starter circuit is advantageously met in a preferred embodiment of the invention by means of an impedance of ohmic character which shunts the capacitive means. This renders a fast discharge possible the moment the charging circuit is interrupted.

A circuit arrangement according to the invention, which also comprises the possibility of controlling the luminous flux, is highly suitable for operating fluorescent and compact fluorescent lamps. In particular, such a circuit is suitable for operating electrodeless fluorescent lamps.

An embodiment of a circuit arrangement according to the invention will be explained in more detail with reference to a drawing.

In the drawing

Fig. 1 shows a circuit arrangement according to the invention, and

Fig. 2 shows a starter circuit forming part of the circuit arrangement according to Fig. 1.

In Fig. 1, A and B are connection terminals for connecting the circuit arrangement to a supply source. Reference numeral 1 denotes a switch-mode power supply which generates a high-frequency pulsatory direct current and which serves as a supply for a DC-AC converter 3. The DC-AC converter comprises two switches 31, 32 which are made conducting alternately by a control circuit 310. The DC-AC converter also comprises a load branch 33 provided with lamp connection terminals 331, 332, between which an electrodeless fluorescent lamp 4 is connected.

The circuit arrangement is further provided with a starter circuit 5 for starting the DC-AC converter.

In Fig. 2, the starter circuit 5 is shown in greater detail. In the starter circuit 5, capacitive means are present in the form of a capacitor 50 by means of which starting pulses are generated through charging of capacitor 50. Means for generating starting pulses comprise a semiconductor switch 52 in a charging circuit of the capacitor 50. The charging circuit further comprises breakdown elements 53 and is connected to control circuit 310 through connection point 501.

The starter circuit also comprises disconnecting means which in the embodiment described are formed by a switching element 54 whose electrode 540 is connected to a control electrode 520 of



semiconductor switch 52.

The capacitor 50 is shunted by discharging means formed by resistor 51, which is an impedance having an ohmic character. The capacitor 50, resistor 51, and switching element 54 are connected to the switch-mode power supply via connection point 502. Switching element 54 is provided with an impedance network 550 for setting the voltage level at which switching element 54 switches (switching level). A resistor 521 is also provided between electrode 520 and electrode 540, and a resistor 522 is provided between electrode 540 and connection point 502 for setting the switching levels of the switches 52 and 54.

Zener diodes 523 are provided between electrode 520 and breakdown elements 53 as a protection against overvoltages.

The operation of the starter circuit is as follows. Immediately after the application of the DC voltage to connection point 502, semiconductor switch 52 becomes conducting via resistors 522 and 521. The moment the pulsatory DC voltage has reached the voltage level of breakdown elements 53, pulsatory charging of capacitor 50 takes place via semiconductor switch 52, breakdown elements 53, connection point 501, control circuit 310, and DC-AC converter 3. This provides a voltage pulse in control circuit 310 by which the DC-AC converter is started. When a value of the pulsatory DC voltage is reached which is higher than the breakdown voltage of the breakdown elements 53, the switching level of switching elements 54 being reached via the impedance network 55, switching element 54 becomes conducting and semiconductor switch 52 is rendered non-conducting. Capacitor 50 will then be discharged through resistor 51.

In a practical embodiment of the circuit arrangement described, semiconductor switch 52 and switching element 54 are constructed as power MOS-FETs, type BST 78. Capacitor 50 has a value of 3,9 nF and resistor 51 of 220 K Ω . Breakdown elements 53 are Diacs of the BR 100 type.

The impedance network 550 is built up from a resistor of 6,8 M Ω in series with a parallel circuit of a 120 K Ω resistor, a 560 pF capacitor, and a protection zener diode having a zener voltage of 12 V. The resistors 521 and 522 have values of 1 M Ω and 2,7 M Ω , respectively.

In a practical embodiment, the switch-mode power supply 1 upon connection to a 220 V, 50 Hz supply source provides a pulsatory DC voltage of 380 V and has a repetition frequency of 200 Hz. The pulse width can be varied between 0 ms and 5 ms, i.e. between 0 and 1 time the period of the repetition frequency. The switches 31, 32 of the DC-AC converter are made alternately conducting with a frequency of 2,65 MHz. The luminous flux of an electrodeless fluorescent lamp operated by

means of the circuit arrangement described can be controlled between 10% and 100% of the rated value.



Claims

1. A circuit arrangement for operating a discharge lamp, provided with a DC-AC converter and with a starter circuit for starting the DC-AC converter, in which starter circuit means are present for generating a starting pulse through charging of capacitive means, characterized in that the starter circuit comprises discharging means for discharging the capacitive means and disconnecting means for keeping the starter circuit disconnected.
2. A circuit arrangement as claimed in Claim 1, in which the means for generating starting pulses comprise a switch in a charging circuit of the capacitive means, characterized in that the disconnecting means comprise a switching element for controlling the switch in the charging circuit of the capacitive means.
3. A circuit arrangement as claimed in Claim 1 or 2, characterized in that the discharging means comprise an impedance of ohmic character which shunts the capacitive means.